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(54) **ANTENNA SYSTEM, IN PARTICULAR FOR POINTING AT NON-GEOSTATIONARY SATELLITES**

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(58) **Field of Search** .... 343/761, 757, 343/758, 765, 766, 781 LA, 781 P, 781 R, 840, 872; H01Q 3/00

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(57) **ABSTRACT**

The invention concerns an antenna system including at least two antennas **(10, 11)**, each of said antennas **(10, 11)** being capable of pointing independently of the other(s) in any direction within a solid angle. According to the invention, the antennas **(10, 11)** are mounted on a common support **(17)** co-operating with rotation means **(18)** for rotating the common support **(17)**, the rotation means **(18)** being activated to prevent masking of one of the antennas **(10, 11)** by another of the antennas **(10, 11)**. The invention applies in particular to tracking non-geostationary satellites.

20 Claims, 2 Drawing Sheets

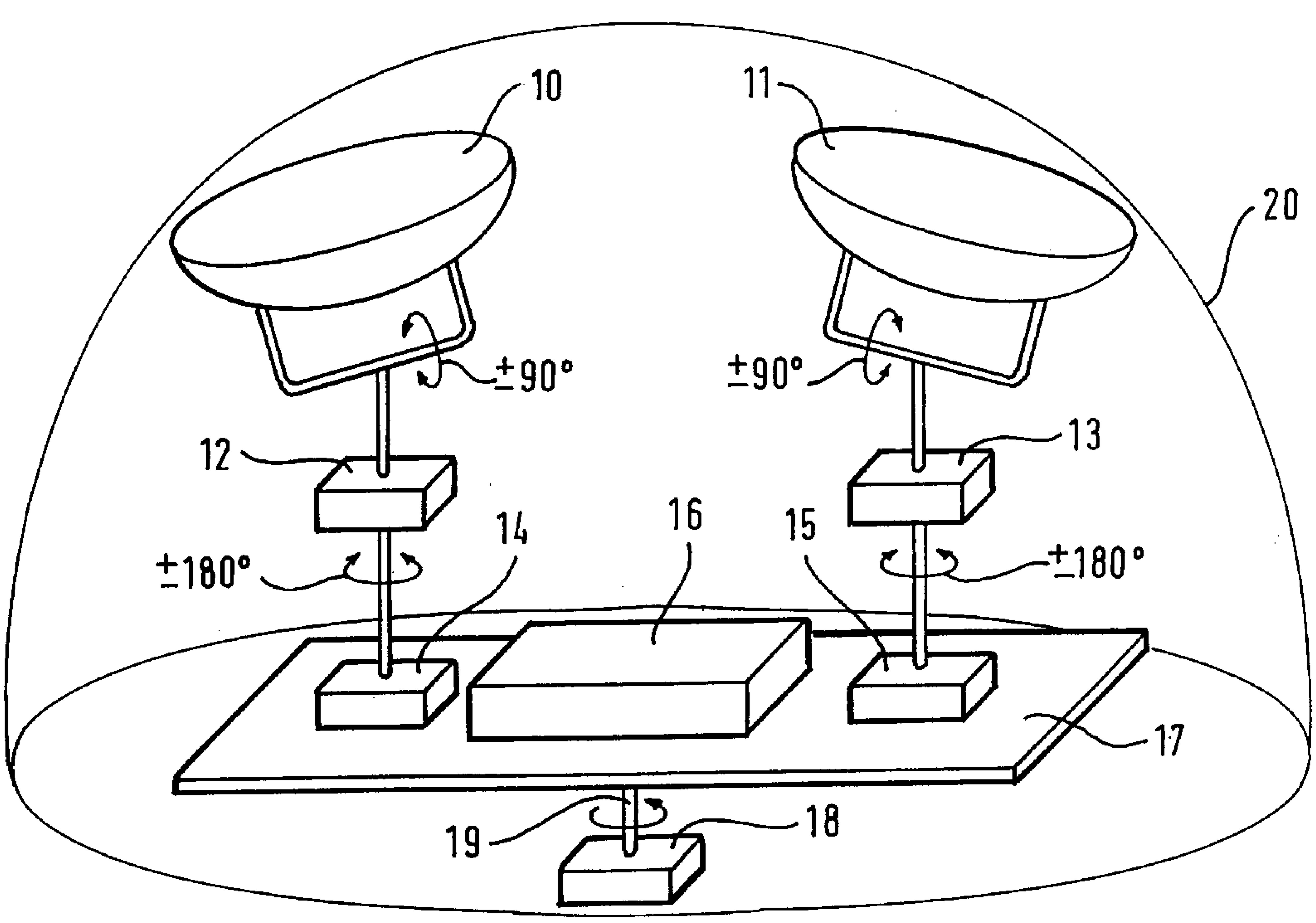
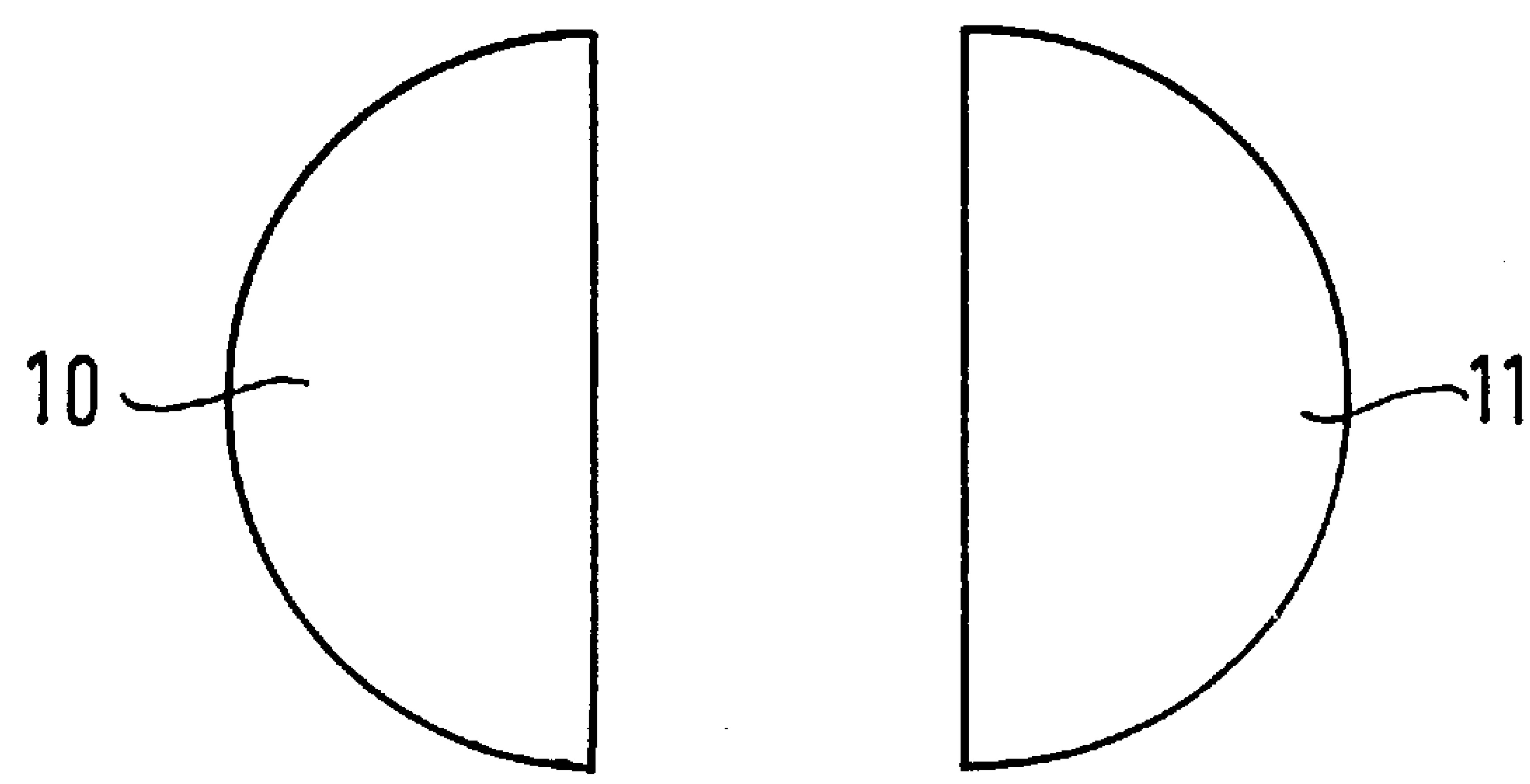
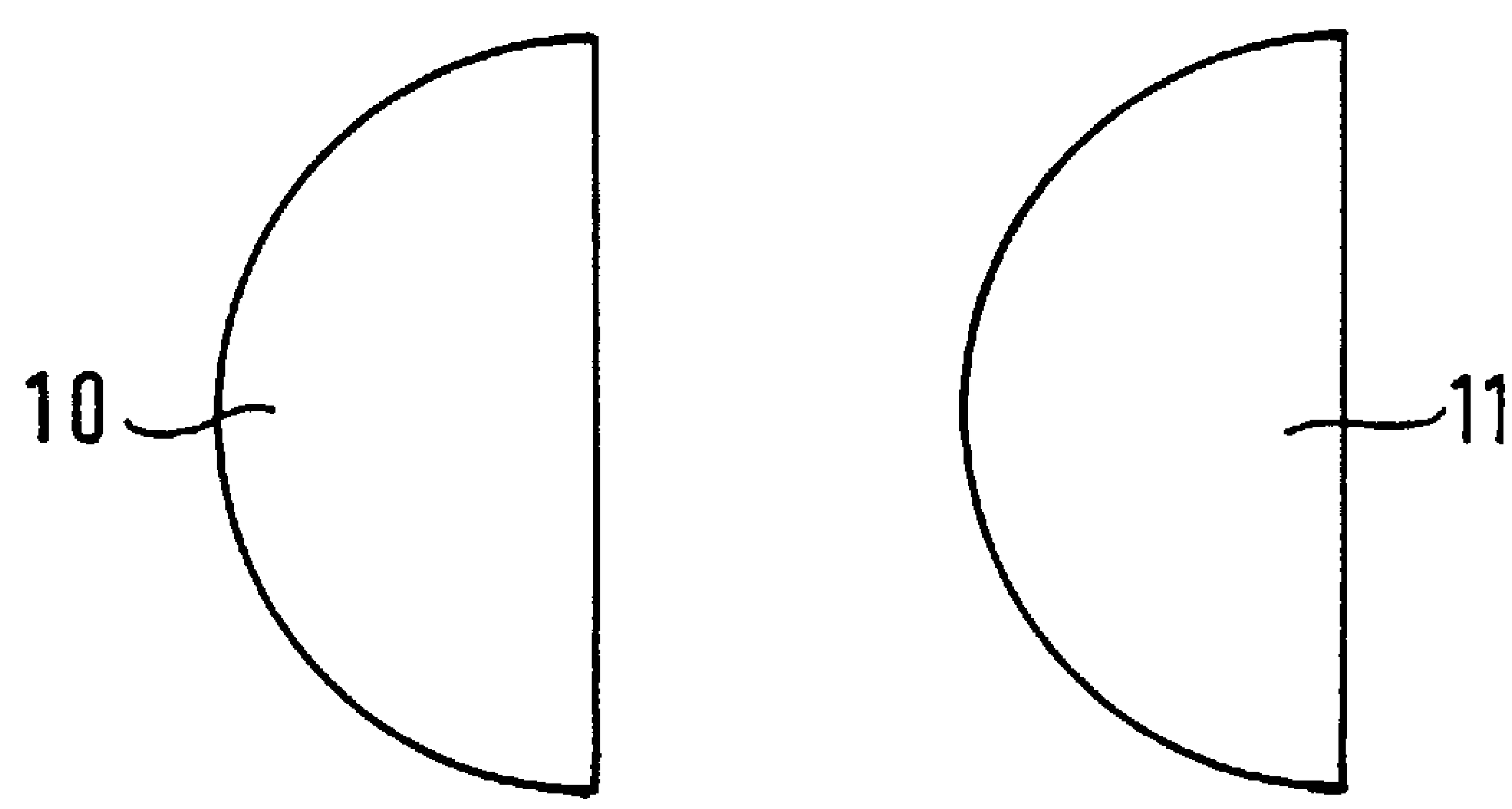


FIG.1



PRIOR ART

FIG.2



PRIOR ART

FIG.4

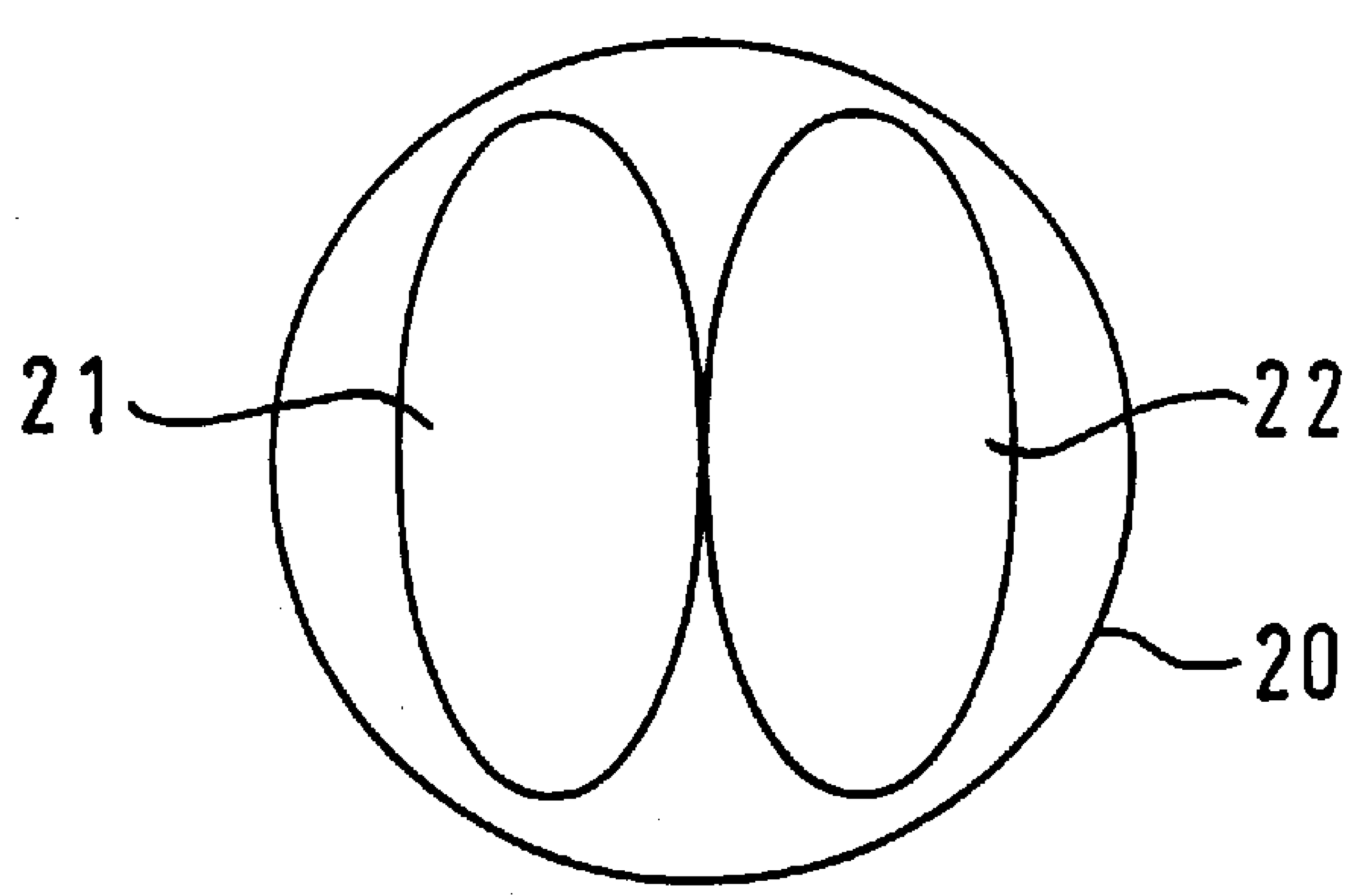
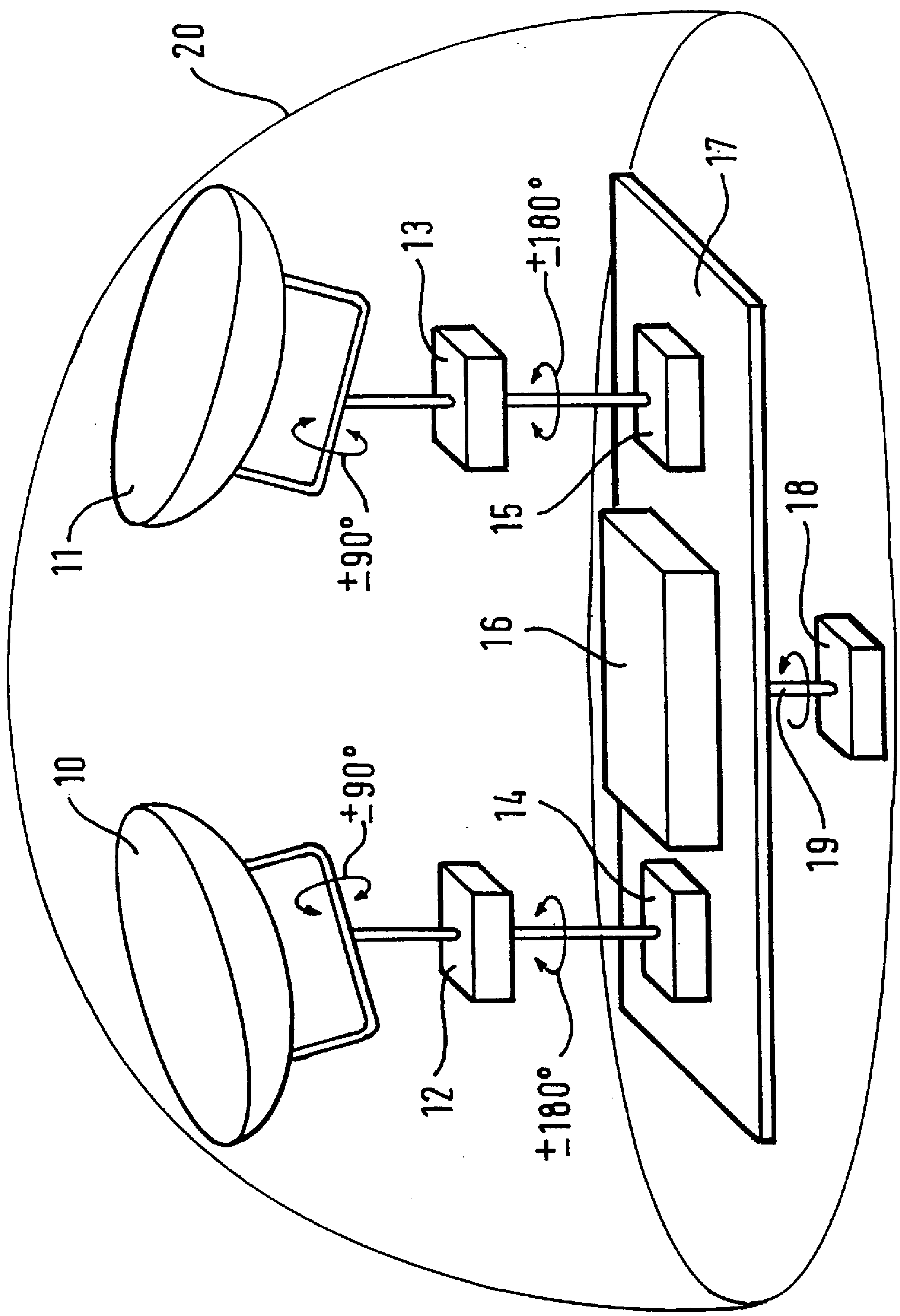


FIG. 3



ANTENNA SYSTEM, IN PARTICULAR FOR POINTING AT NON-GEOSTATIONARY SATELLITES

BACKGROUND OF THE INVENTION

The field of the invention is that of antenna systems, in particular for pointing at non-geostationary satellites. To be more precise, the present invention concerns a system with at least two antennas capable of pointing independently of each other in any direction within a solid angle.

In the context of the present invention, a terrestrial transmission system is considered, e.g. as installed on the roof of a building. The system includes at least two antennas, for example parabolic antennas, designed to communicate with, i.e. to transmit to and/or receive from, non-geostationary satellites. The antennas are close together (i.e. co-located) for reasons of overall size and/or to reduce the lengths of the connections to a single modem and/or so that they can be located under the same protective radome. The two antennas can be steered independently of each other in azimuth and in elevation, i.e. each is mounted on a separate support.

The problem that arises with a system of the above kind is that one antenna may mask the other antenna(s), as shown in FIGS. **1** and **2**, because of the position of the satellites, and in particular when their elevation is low. The antennas are considered to be located in the same horizontal plane, i.e. at the same height.

In FIG. **1**, which is a simplified plan view of a system with two co-located parabolic antennas, the two antennas **10** and **11** are pointing in opposite directions and neither of them can transmit or receive signals because they mask each other. In FIG. **2**, the antennas **10** and **11** are pointing in the same direction and the antenna **11** is therefore masking the antenna **10**.

To avoid such masking, it is possible to move the antennas a greater distance apart, the requirements for compactness are then no longer satisfied. Also, it is no longer possible to protect them by a common radome.

One object of the present invention is to remedy the above drawbacks.

SUMMARY OF THE INVENTION

To be more precise, one object of the invention is to provide an antenna system including at least two antennas each of which is capable of pointing independently of the other(s) in any direction within a solid angle, the system enabling the antennas to be colocated without masking each other.

The above object, and others that become apparent below, are achieved by an antenna system including at least two antennas, each of the antennas being capable of pointing independently of the other(s) in any direction within a solid angle, the system being characterized in that the antennas are mounted on a common support cooperating with rotation means for rotating the common support, the rotation means being activated to prevent masking of one of the antennas by another of the antennas.

Rotation of the common support enables the antennas to be disposed beside each other for aiming in the same direction or opposite directions.

The antennas used can be circular or elliptical parabolic antennas, i.e. passive antennas, or active antennas made up of patches.

The rotation means are preferably adapted for rotation of ±45° relative to a median position.

The antenna system is advantageously covered by a radome and the invention applies in particular to tracking non-geostationary satellites.

BRIEF DESCRIPTION OF THE DRAWINGS

Other features and advantages of the invention become apparent in the course of the following description of a preferred embodiment of the invention which is given by way of illustrative and non-limiting example only and with reference to the accompanying drawings, in which:

FIGS. **1** and **2** are simplified plan views of a system with two co-located parabolic antennas,

FIG. **3** shows an antenna system according to the present invention, and

FIG. **4** is a simplified plan view of an antenna system of the invention including elliptical antennas.

DETAIL DESCRIPTION OF THE INVENTION

FIGS. **1** and **2** have already been described in connection with the prior art.

FIG. **3** shows an antenna system in accordance with the present invention. Here there are two circular parabolic antennas (**10** and **11**). Each antenna is mounted on a support and can be pointed independently of the other in any direction within a solid angle by means of elevation positioning means **12**, **13** (each of which can rotate the antenna with which it co-operates by ±90° in elevation, for example) and azimuth positioning means **14**, **15** (each of which can rotate the antenna with which it co-operates by ±180° in azimuth, for example). Common transmit/receive means **16** are connected to the antennas **10** and **11**.

According to the invention, the antennas **10** and **11** are mounted on a common support **17** co-operating with means **18** for rotating the common support **17**. To be more precise, the azimuth positioning means **14**, **15** of the antennas **10** and **11** are here mounted on the common support **17**. The rotation means **18** are activated to prevent one antenna masking the other antenna. For example, the rotation means comprise a motor coupled directly to a shaft **19** fixed to the common support **17**. The common support **17** is rotated through ±45° relative to a median position when future impediment of one antenna by the other antenna is predicted, for example. The prediction can be based on analyzing the ephemeris or on analyzing data from encoders which encode the positions of the antennas **10** and **11**. This automatically assures that neither antenna is ever masked by the other antenna, whether they are facing in substantially opposite directions (FIG. **1**) or in substantially the same direction (FIG. **2**).

The antennas can equally well be active antennas.

The invention enables the antenna system to be placed under a common protective radome **20**, which then has a compact overall size.

To limit further the overall size of the antenna system of the invention, the antennas can be oval or elliptical, as shown in FIG. **4**. This figure is a simplified plan view of the antenna system of the invention with the antennas **21** and **22** under the radome **20** aimed at the zenith. The surface areas of the antennas **21** and **22** are equal to those' of the antennas **10** and **11**, in order to provide the same performance. The radome **20** is smaller (around 20% smaller) than that shown in FIG. **3**.

The invention applies in particular, although not exclusively, to tracking non-geostationary satellites.

What is claimed is:

1. An antenna system including at least two antennas (**10**, **11**, **21**, **22**), each of said antennas (**10**, **11**, **21**, **22**) configured to operate independently in any direction within a solid angle, wherein said antennas (**10, 11, 21, 22**) are mounted on a common support (**17**) co-operating with rotation means (**18**) for rotating said common support (**17**), said rotation means (**18**) being activated to prevent masking of one of said antennas (**10, 11, 21, 22**) by another of said antennas (**10, 11, 21, 22**).

2. A system according to claim **1**, wherein said antennas (**10, 11, 21, 22**) are parabolic antennas.

3. A system according to claim **1**, wherein said antennas are active antennas.

4. A system according to claim **1**, wherein said rotation means (**18**) is configured to effect a rotation of ±45° relative to a median position.

5. A system according to claim **1**, wherein said antennas are covered by a radome (**20**).

6. A system according to claim **1**, wherein said antennas (**21, 22**) are elliptical.

7. A system according to claim **1**, wherein said antennas are configured to track non-geostationary satellites.

8. The system of claim **1**, wherein said rotating means positions said common support in response to data indicative of relative rotational positions of said antennas.

9. The system of claim **1**, wherein said rotating means operates in response to location data that forecasts a masking event.

10. A method for communicating with a non-geostationary object, comprising:

orienting a plurality of antennas with respect to the non-geostationary object, said plurality of antennas attached to a common base, the pointing direction of said antennas being controllable independently of each other;

generating a location data indicative of relative positions of each of said plurality of antennas with respect to one another; and

positioning said common base in response to said location data to substantially eliminate masking.

11. The method of claim **10**, wherein said generating step comprises analyzing information indicative of relative rotational positions of the antennas to generate the location data.

12. The method of claim **11**, wherein said information indicative of relative rotational positions is obtained by analyzing one of an ephemeris and encoded positional data from said plurality of antennas.

13. The method of claim **10**, further comprising forecasting a masking event of at least one of said plurality of antennas by another of said plurality of antennas to generate the location data, wherein the location data is a prediction.

14. The method of claim **10**, further comprising adjusting azimuth and elevation of said plurality of antennas.

15. The method of claim **10**, wherein said plurality of antennas is covered by a single radome.

16. The method of claim **10**, wherein the positioning step includes rotating the common base ±45° relative to a prescribed position.

17. The method of claim **10**, wherein said plurality of antennas is parabolic.

18. The method of claim **10**, wherein said plurality of antennas is active.

19. The method of claim **10**, wherein said plurality of antennas is elliptical.

20. The method of claim **10**, wherein a rotating means positions said common base.

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